

WHAT IS CLAIMED IS:

- 1                    1.     A spray tool apparatus for spraying polyurethane, comprising:  
2                    a plurality of supply sources, each supply source containing one of  
3                    a plurality polyurethane constituents;  
4                    a plurality of recirculating fluid circuits each in fluid flow  
5                    communication with one of the supply sources for distributing one of the  
6                    polyurethane constituents;  
7                    a mix head connected to each of the fluid circuits that receives from  
8                    each fluid circuit one of the polyurethane constituents, the mix head having a  
9                    chamber in which the plurality of polyurethane constituents are mixed to form a  
10                    polyurethane mixture;  
11                    a hydraulically operated valve for controlling the flow of the  
12                    polyurethane constituents to the mix head, the valve having a first position in which  
13                    the polyurethane constituents flow into the chamber of the mix head and a second  
14                    position in which the polyurethane constituents are recirculated through the fluid  
15                    circuits without being mixed in the mixing chamber; and  
16                    a spray nozzle assembly through which the polyurethane mixture is  
17                    dispensed when the valve is in the first position.
- 1                    2.     The apparatus of claim 1 wherein the polyurethane  
2                    constituents are polyol, isocyanate, and pigmented polyol.
- 1                    3.     The apparatus of claim 1 wherein the recirculating fluid  
2                    circuits each have a separate pump for pressurizing one of the polyurethane  
3                    constituents.
- 1                    4.     The apparatus of claim 1 further comprising a liquid solvent  
2                    supplied to the mix head under pressure to purge the polyurethane mixture from the  
3                    chamber in the mix head and the spray nozzle assembly when the valve is in the  
4                    second position.

1                    5.        The apparatus of claim 1 wherein the hydraulically operated  
2 valve has a hydraulically actuated piston that is provided with separate channels for  
3 each of the polyurethane constituents through which the constituents flow when the  
4 valve is in the second position.

1                    6.        The apparatus of claim 1 wherein the hydraulically actuated  
2 valve is operated by a hydraulic fluid circuit that has a reciprocating piston that  
3 shifts the valve between the first and second positions.

1                    7.        The apparatus of claim 1 wherein the hydraulically actuated  
2 valve is operated by a hydraulic fluid circuit that has a reciprocating piston that  
3 shifts a valve spool within an elongated chamber, the valve spool and chamber being  
4 sealed relative to each other as the valve spool moves between the first and second  
5 positions.

1                    8.        The apparatus of claim 7 further comprising a seal secured to  
2 the valve spool that seals against the chamber.

1                    9.        The apparatus of claim 1 wherein the spray nozzle assembly  
2 has a tubular portion and a static helical mixing vane disposed in the tubular portion  
3 that mixes the polyurethane mixture before the polyurethane mixture is dispensed  
4 through a nozzle tip.

1                    10.       The apparatus of claim 1 wherein the mixture of polyurethane  
2 is sprayed on a mold to form a polyurethane skin for a vehicle interior part.

1                    11.       A method of forming a polyurethane skin for an interior part  
2 of a vehicle, comprising:  
3                    pumping an isocyanate composition to a mix head;  
4                    pumping a polyol composition to the mix head;  
5                    opening a valve selectively to allow the polyol composition and the  
6 isocyanate composition to be injected under pressure into a mixing chamber defined  
7 by the mix head in a first position to create a polyurethane reactant mixture;

8 closing the valve selectively to allow the polyol composition and  
9 isocyanate composition to be recirculated through the valve in a second position;  
10 moving the valve with a hydraulically actuated cylinder that moves  
11 a valve element within a valve body between the first position and the second  
12 position;  
13 dispensing the polyurethane reactant mixture through a spray nozzle;  
14 and  
15 shaping the polyurethane reactant mixture on a mold surface to form  
16 a polyurethane skin.

1 12. The method of claim 11 further comprising mixing the  
2 polyurethane reactant mixture with a static helical mixing vane disposed in a tubular  
3 portion of the spray nozzle.

1 13. The method of claim 11 further comprising spraying a solvent  
2 into the mixing chamber when the valve is in the second position to purge the  
3 polyurethane reactant mixture from the mixing chamber and the spray nozzle.

1 14. The method of claim 11 wherein the valve element further  
2 comprises a piston that is provided with a first separate channel for the isocyanate  
3 composition and a second separate channel for the polyol composition, wherein each  
4 of the compositions flow through one of the separate channels when the valve is in  
5 the second position.

1 15. A method of forming a polyurethane skin for an interior part  
2 of a vehicle, comprising:  
3 pumping an isocyanate composition to a mix head;  
4 pumping a polyol composition to the mix head;  
5 pumping a pigmented polyol composition to the mix head;  
6 opening a valve selectively to allow the polyol composition, the  
7 isocyanate composition, and the pigmented polyol to be injected under pressure into  
8 a mixing chamber defined by the mix head in a first position to create a pigmented  
9 polyurethane reactant mixture;

10 closing the valve selectively to allow the polyol composition,  
11 isocyanate composition, and the pigmented polyol to be recirculated in a second  
12 position;  
13 moving the valve with a hydraulically actuated cylinder that moves  
14 a valve element within a valve body between the first position and the second  
15 position;  
16 dispensing the pigmented polyurethane reactant mixture through a  
17 spray nozzle; and  
18 shaping the pigmented polyurethane reactant mixture on a mold  
19 surface to form a polyurethane skin.

1 16. The method of claim 15 further comprising mixing the  
2 pigmented polyurethane reactant mixture with a static helical mixing vane disposed  
3 in a tubular portion of the spray nozzle.

1 17. The method of claim 15 further comprising spraying a solvent  
2 into the mixing chamber when the valve is in the second position to purge the  
3 pigmented polyurethane reactant mixture from the mixing chamber and the spray  
4 nozzle.

1 18. The method of claim 15 wherein the valve element further  
2 comprises a piston that is provided with a first separate channel for the isocyanate  
3 composition, a second separate channel for the polyol composition, and a third  
4 separate channel for the pigmented polyol composition, wherein each of the  
5 compositions flow through one of the separate channels when the valve is in the  
6 second position.